TROPICAL CYCLONE MOTION STUDIES

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LONG TERM GOALS:

The long-term goal is to improve the prediction of tropical cyclone track and structure so that warnings of the Fleet units afloat and ashore are optimized.

OBJECTIVES:

1) Improve tropical cyclone track prediction by demonstrating that objective aids tailored to specific synoptic pattern/region combinations provide better guidance than existing objective aids. (2) Improve the specification of the initial outer wind structure in the tropical cyclones for numerical models and for forecaster understanding of the tropical cyclone-environment structure, and for use in surface wind warnings.

APPROACH:

(1) Exploit the synoptic pattern/region assignment for western North Pacific tropical cyclones during 1989-95 to test the improvement of a statistical-synoptic technique over the operational CLIPER technique, and then append a composited post-transition track to improve track prediction during environment structure transitions. (2) Exploit an angular momentum model proposed by Carr and Elsberry (1994) to define the outer tangential wind profile, and use three methods to estimate the cyclonic wind extent in one of four size categories.

RESULTS:

(1) For a statistical-synoptic equation set derived and tested with tropical cyclones in the Standard/Dominant Ridge pattern/region for the entire 72-h forecast interval, the improvement relative to the operational CLIPER is 13% after only 12 h and increases to 24% at 72 h. For the Poleward/Poleward-oriented pattern/region, the improvement relative to the operational CLIPER is about 14% after 12 h, and is about 11% at 72 h. Given a perfect knowledge of the type and timing of two transitions, the appending of a composited post-transition track can led to about 50% reduction relative to the 72-h operational CLIPER errors if the transition occurs early in the forecast interval. This result is a validation of the environmental structure change focus of the

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systematic approach (Chen *et al*.1997a; 1997b). (2) Based on the JTWC-specified wind radii during the intensification phase of western North Pacific tropical cyclones, 60% had continual growth, 24% contracted, and 16% maintained relatively constant in cyclone wind extent. During the decaying phase, 65% decreased, 29% had continued growth, and 6% had a relatively constant cyclonic wind extent. A satellite-based method of estimating extent generally agreed with the wind radii estimate, except that more large tropical cyclone were specified. A multi-quadric interpolation analysis of composited wind observations produces objective estimates of wind radii, and thus the outer wind structure, for larger tropical cyclones. A combination of the multiquadric approach and the satellite method is recommended to improve the JTWC wind radii specifications (Elsberry *et al*. 1997a; 1997c).

TRANSITIONS:

(1) The wind structure estimation procedures will be transferred to JTWC for operational testing. (2) The feasibility of the two statistical-synoptic regression approaches will be demonstrated with the working best-track positions as part of a 6.4 project funded by SPAWAR and offered to JTWC for operational testing.

RELATED PROJECTS:

Separate summaries of collaborative work with Lester Carr (two projects), Patrick Harr, and Elizabeth Ritchie are included elsewhere in this volume.

Supplementary activities include: (1) Organization of the ONR Tropical Cyclone Workshop, Melbourne, Australia, December 1996 (Abbey and Elsberry 1997); (2) Leading a review of the Tropical Prediction Center/National Hurricane Center (Elsberry *et al*. 1997d); and (3) Representing ONR on the U.S. Weather Research Program Science Steering Committee, with specific duties as co-chair of the Hurricane Landfall Workshop to design a five-year research plan.

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